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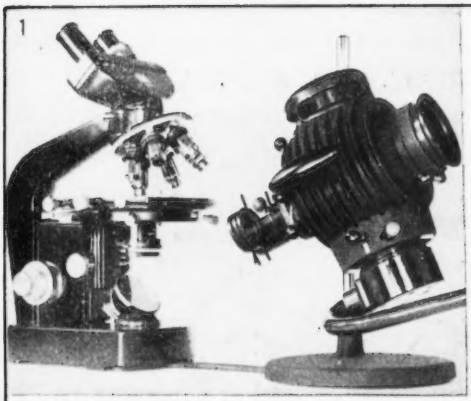

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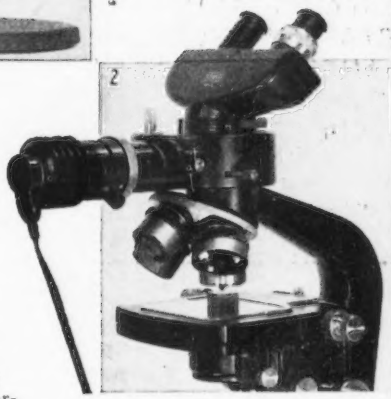

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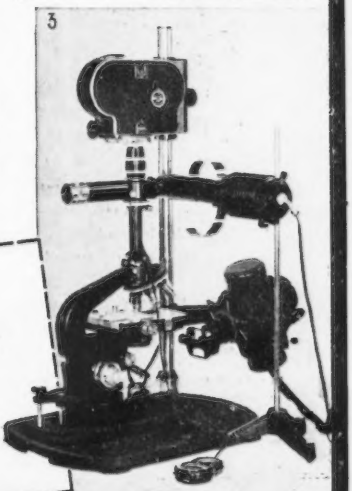

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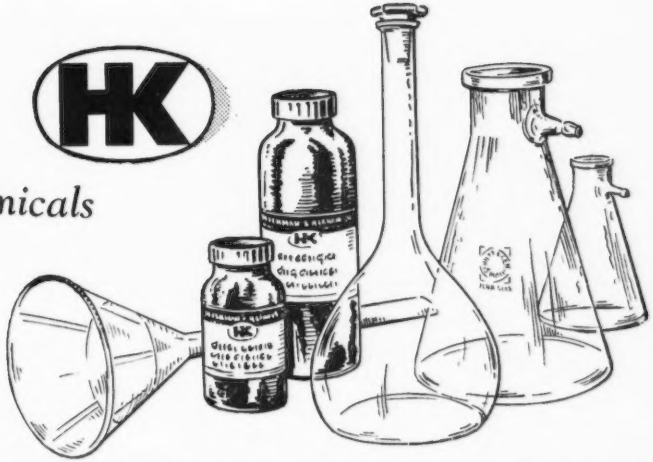

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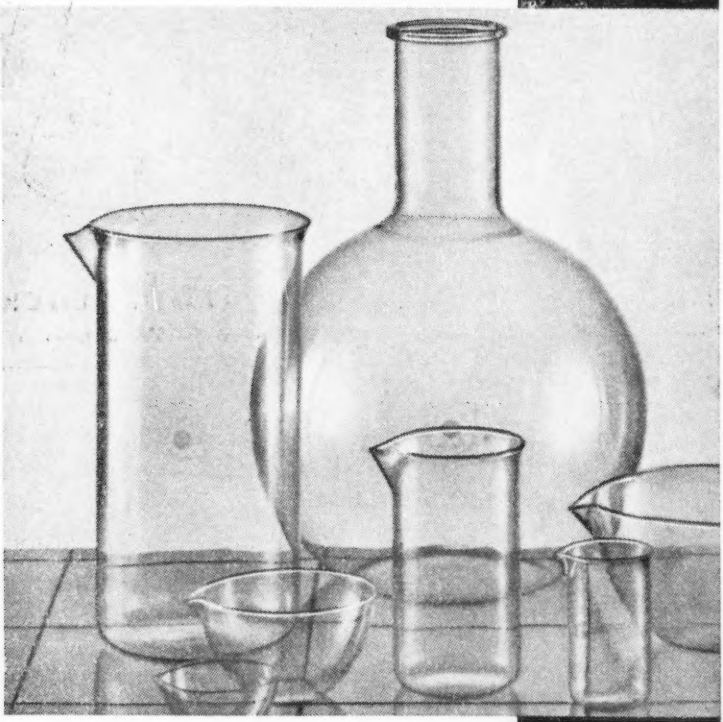

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Editorial

LABOUR WORTHY OF HIRE

The medical technologist can be excused for his habit of greeting with a somewhat sceptical smile the old saw about the labourer being worthy of his hire. The majority of medical technologists today feel that an interest in the welfare of the sick is expected, in some part, to provide sustenance for their families.

It has recently been said, by an otherwise intelligent investigator into laboratory conditions, that the medical technologist has no responsibilities. Let us then consider a senior medical technologist and a senior clerk. The former will have undergone, of necessity, a long course of training, a course which is never-ending if he is to keep himself abreast of recent developments in his field. He is expected to be available to his laboratory at all times and is usually serving on a roster of availability for emergency calls to his laboratory. His hours are often elastic and it is by no means uncommon for a laboratory worker to contract an illness associated with his work. In short, his time is the laboratory's.

His clerical colleague may have attended classes to improve his education and knowledge. It is usually not obligatory for him to do so. By being steady he rises through the grades and his maximum is almost always way above that of a technologist. Why there should be this disparity we are at a loss to understand, but it does exist.

Our aim, since the inception of this Society, has been to provide well trained medical technologists but we have found that those we train leave us for better paid fields in administrative grades and also as "medical representatives" and we ask ourselves why men of proven worth should have to leave their chosen profession in order to be able to maintain and educate a family.

Perhaps we have been taken for granted for too long !

Van die Redakteur

DIE ARBEIDER EN SY LOON

Mens kan die mediese tegnoloog dit vergewe as hy ietwat skepties staan teenoor die ou afgesaagde gesegde dat die arbeider sy loon werd is. Deesdae voel die meeste mediese tegnoloë dat hulle belangstelling in die welvaart van siekmense tenminste gedeeltelik erken behoort te word in die vorm van vergunnings sodat hulle daardeur beter geleenthede vir hulle families kan verkry.

Kort gelede is daar opgemerk, deur iemand wat gewoonlik as 'n intelligente waarnemer van laboratoriumaangeleenthede bestempel kan word, dat die mediese tegnoloog geen verantwoordelikheid dra nie. Laat ons nou die geval van die senior mediese tegnoloog teenoor diê van die senior klerk beskou. Eersgenoemde sal noodwendig jare van opleiding ondergaan moes het—'n opleiding wat nimmereindigend is vir die tegnoloog wat op hoogte van sake wil bly met die nuwerwetse ontwikkelinge in tegnologie. Hy word verwag om ten alle tye beskikbaar te wees vir diens in sy laboratorium en moet dikwels nog boonop noooddienste lewer. Sy werksure is derhalwe grootliks onbeperk. Verder is dit ook nie ongewoon vir 'n laboratorium tegnoloog om 'n siekte op te doen wat regstreeks met sy werk in verband staan nie.

Sy kollega in die klerikale afdelings mag moontlik studeer het om sy geleerdheid en kennis uit te brei—sonder dat dit noodwendig van hom geverg geword is. Hy kry sy verhoging en word geleidelik bevorder, en uiteindelik is sy maksimum salaris ver bo dié van die tegnoloog. Waarom daar hierdie verskil gemaak word—en dat so 'n verskil wel bestaan is seker—is vir ons 'n oplosbare kwessie.

Ons doel, sedert die stigting van die Vereniging, was nog altyd om tegnoloë ten beste van ons vermoë op te lei maar, ons ondervinding is dat baie van dié wat ons oplei mediese tegnologie versaak vir betrekkings in administrasie afdelings of, so nie, te werk as „mediese verteenwoordigers" van firmas. Die finansiële vergoeding is gewoonlik veel beter vir sulke poste. Ons vra ons self af waarom dit so moet wees dat mense hul gekose beroep moet prysgee om daardeur beter geleenthede vir hulle families te kan skep.

Moontlik is ons dienste onder al hierdie omstandighede reeds te lank as vanselfsprekend beskou !

THE LIGHTING OF MICROSCOPIC OBJECTS

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by GONZAGUE KISTLER

During recent decades microscopy has become very extensively adopted. Its classic [1]research methods (bright field, dark field, phase contrast, floresence and polarization) are to-day generally accessible; microphotography and microcinematography are continually being used in practice. The appliances and accessories necessary for these have become more suitable and also easier to handle ; their specific performance has to a great extent reached the limit of what is technically possible, in so far as concerns the high quality of the work done.

One problem, which is very probably as old as microscopy itself, remains, however, always important : *the effective lighting of the preparation that has to be examined.* Between the first microscope equipped with a special lighting device (as one, we mention the instrument developed by R. Hooke, see fig. 1) and the modern research appliances with built-in electric light source, there have been nearly three centuries of practical and theoretical development. With the introduction of the many methods of observation, some of which have become extraordinarily important and are generally adopted to-day, also the demands made on the lighting equipment of the microscope have become much more severe. Because of this, at the present day defective brightness of the preparation still acts to-day as a limiting factor, all the more since all technically imaginable sources of light have not proved equally suitable for microscopy and microphotography.

SOURCES OF LIGHT USED IN MICROSCOPY, AND THEIR PHYSICAL BASES

A comparison between different sources of light is only possible by considering their most important physical characteristics, and then the measurements of the rays coming into question can be carried out in two ways :

If the calculation is based on the *total radiation* of the source of light, including infra-red (IR) and ultra-violet (UV), the effectiveness of the rays can be expressed direct in watts, as is the case, for example, in the usual commercial incandescent lamps, in electron flash tubes and gaseous discharge tubes.

If the emitted light is only in the *visible spectrum* (*between* 400 *and* 700 n*m.*),[2] the following internationally determined units of photometry hold good, amongst others, and make it possible to come to a much better conclusion regarding certain elementary qualities of a source of light. These are :

(1) As distinguished from electron microscopy, the instruments for which are built according to other principles.
(2) nm = nanometer: 1 nm = 10 A = 10 - 9m.

LIGHT INTENSITY

The unit of light intensity is the candle (cd). It is based on the radiation from a cavity of thorium oxide, whose luminous density at the temperature of solidification of platinum (2046°K) amounts to 60 candles per cm^2. The light intensity of a point source of light in a desired direction is the quotient of the light flux in this direction and of the solid angle through which the rays pass.

Fig. 1. Microscope of R. Hooke (1635--1703) from a publication in the year 1665. All portions of the illuminating device can already be separately adjusted; for increasing the strength of lighting, the tube (section above) can be filled with water.

LIGHT FLUX

The unit of light flux is the lumen (lm), the light flux amounting to 1 lumen when the unit light intensity of 1 candle exists within a solid angle of 1 steradian (1 str.). The light flux is that portion of the radiation emitted from a glowing body which is sensitive to the eye as light.

LUMINOUS DENSITY

The unit of luminous density is the stilb (sb). It is the luminous density of a source of light with the light intensity of one candle and a visible surface of 1 cm^2. The luminous density of a glowing element of surface in a certain direction is the quotient of the intensity of light of the element of surface in this direction and of the parallel projection of the element of surface onto the plane at right angles to the direction of radiation.

Another practically very important characteristic of a source of light is the *colour temperature*. We have here to deal with a temperature value which serves for designating the light-colour from light sources with continuous spectrum. In a simple manner, the colour temperature can be regarded as a measurement for the proportion of the parts of a light source in shortwave and longwave radiation (blue and red).

The exact measuring of the colour temperature is effected in such a way that uniformity of colour is established between the lamp in question and the "absolute black body" (temperature radiator of strict uniformity of radiation in accordance with law in dependence on its true temperature). The actual temperature of the black body necessary for this, is called the colour temperature of the lamp.

In microscopy the *luminous intensity* (sb) as well as the *colour temperature* (°K) are in particular of great importance. Starting with the fact that in microscopic investigation technique the most widely adopted Köhler illuminating system is based on the source of light being as *far as possible pointed*, the luminous density of the same is decisive for the brightness of the preparation that can be realized by an optimum lighting apparatus. The colour temperature of the light plays an important part both in the visual observing of coloured preparations and also in their photographic reproduction. Some other questions concerning this will be considered later on.

A comparison of the different types of lighting used in connection with the microscope shows the following aspects when what has been said above is taken into consideration :

NATURAL LIGHTING

The oldest and simplest source of light for illuminating a microscopic object is natural *daylight* picked up by a plane or concave mirror. This light, which contains in a continuous spectrum all spectral colours from red through orange, yellow, green, blue to violet in a definite proportion to each other, is termed "*white*."

Assuming a sufficient luminous density and also a *constant* colour temperature, daylight could be described as the ideal light source for practically every requirement of microscopic research, since it on the one hand corresponds to a great extent to the spectral brightness sensitivity of the human eye (cf. fig 2) ; on the other hand the most selective colourings of microscopic technique are based on the use of white light

for illuminating. In contrast to that, however, every practical man is well aware of the fact that the intensity of daylight, even in the most favourable case, can hardly provide sufficient illumination for an ordinary light-field preparation under strong magnification, whilst—contrary to a still widely held opinion—the colour temperature of this light is anything but constant. Thus the spectral composition of daylight on sunny

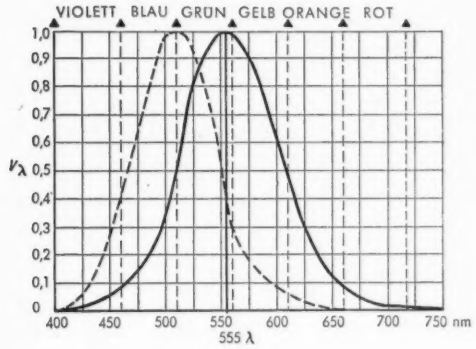


Fig. 2. Spectral brightness-sensitivity of the human eye. Curves: —— eye adapted to brightness ("pivot plane"), ---- eye adapted to darkness (plane of end of optic nerve). (Oben) violet, ,blue, green yellow, orange red.

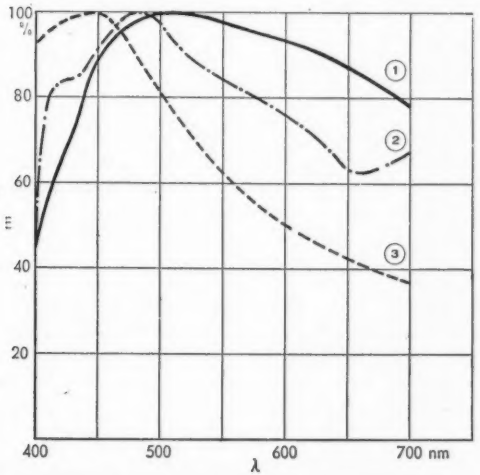


Fig. 3. Distribution of energy in the spectrum of different kinds of daylight. Curves: —— (1) sunlight at the surface of the earth (Zenith distance 25°), —·—·—. (2) clouded, sky, ---- (3) blue sky.

days varies between 2,000 and 6,500° K, whilst measurements on a blue northern sky have given colour temperatures up to 25,000° K. A certain standardisation could be obtained if "daylight" was described as a radiation consisting of skylight and pure sunlight and having a colour temperature of 6,500° K. Because of these fluctuations in the spectral composition of daylight, which may sometimes be very considerable, it is perfectly obvious that colour conditions result which render it difficult to have a differentiated observation of the microscopic object (cf. fig. 3).

It is therefore clear that industrial research has devoted considerable efforts in order to endeavour to give the microscopist an *artificial* source of light with intense illumination and as similar as possible to daylight and having constant radiation. Since it would lead too far to give a survey of all solutions which have been advanced in the attempt to solve this problem, some of them in a very original manner, we shall here only refer to those light sources which have become of general use in microscopy.

ARTIFICIAL LIGHTING

As new sources of artificial light for visual observation, for taking microphotographs, and also for projecting a microscopic preparation, besides the normally used low-voltage incandescent lamps in many variations, the mercury high-pressure burner and the carbon arc lamp are particularly well known. All three types have proved excellent within limited ranges, but have deficiencies that prevent them from being widely adopted in microscopy, these deficiencies having to be attributed on the one hand to limited lighting intensity and to the spectral composition of the emitted light, and on the other hand also to a certain difficulty in handling in practical use.

Low-voltage incandescent lamps : the modern low-voltage flat-filament lamps constructed for microscopic purposes constitute, to-day, the standard electrical equipment of a microscope stand which claims to be mechanically-optically complete. Because of their low price and their long life they have helped artificial microscope lighting to become successful, particularly since, if properly utilized, they suffice for most requirements of daily *routine research*, need no attendance and are also very well suited for microphotography unless short times of exposure are necessary. These types of lamps have, with the materials used to-day (tungsten compounds), practically reached the limit of their possible performance (1,500–2,500 sb ; 3,000–3,400° K) with regard to their lighting intensity and the spectral composition of the emitted light. Nevertheless, for investigation *with high magnification in methods of observation that absorb much light* (phase contrast, dark field, fluorescence, polarization) they are too weak for visual examination, and in many cases annot be adopted at all for microphotographs and microcinematic films. With the given values, their colour temperature is relatively low

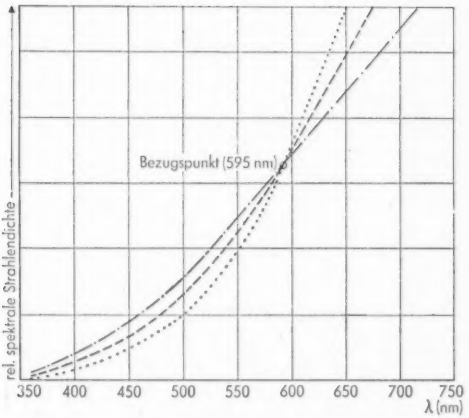


Fig. 4. Spectral curves of emission of a low-voltage flat-spiral filament lamp (6 V., 20. W.).
Curves:
.—.—. Emission at over-voltage 8 V.
- - - - - Emission at normal voltage 6 V
..... Emissions at undervoltage 4 V.
(Left) Relative spectral density if radiation.
(in centre) Reference point (595 nm.).

and also very dependent on the electric load, even small fluctuations in the sense of lowering the voltage will lead to an overstressing of the longwave spectral portions (orange and red, (cf. fig. 4.).

The same effect of a movement in the direction of longer wavelengths is, although to a much less degree, to be observed as such an incandescent lamp gets older. In all these cases the conditions for microscopic observation and photographing become worse, and in addition it must be pointed out that in extreme cases even the resolving power of the microscope optical system may become diminished, since this depends among other things also on the wavelength of the light used for illumination, in the sense that it diminishes when the wavelength increases :

$$d = \frac{\lambda}{2\,n\,.\,A} = \frac{\text{Wavelength of the light}}{2 \times \text{numerical aperture}}$$

(d=grid constant=minimum distance between two points in the preparation which have to be reproduced separately by the optical system of the microscope : limit of the resolving possibility).

In colour microphotography, even in the case of relatively slight deviations ($\pm$200° K) from the prescribed colour temperature (3,200° K for the usual artificial lighting material or 3,800 °K for Kodak F film), very disturbing colour striae make their appearance. It is the case that

by adopting these types of lamp with overvoltage as well as by correcting the spectral composition of the emitted light by colour filters, an improvement of the working conditions can be obtained, but in the first case the life of the incandescent lamp rapidly becomes shorter, whilst in the second case the practical man generally has no possibility of forming an exact idea of the extent of the changes made.

Mercury high-pressure lamps : Mercury burners have within the visible spectrum an enormous lighting density (about 25,000 sb). Because of the pronounced amounts of shortwave radiation (UV and blue light),

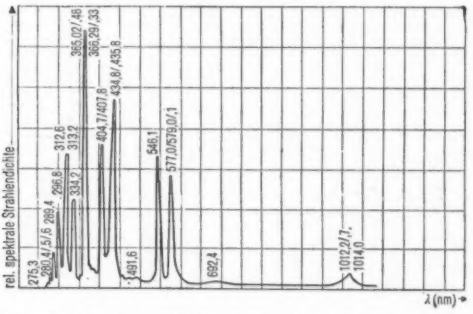


Fig. 5. Spectral emission curve of the mercury vapour high-pressure lamp HBO 200 (middle of arc). (Left) Relative spectral density of radiation.

they form the most suitable source of light for all examinations in ultra-violet and also in fluorescent microscopy. The mercury high-pressure lamp becomes increasingly important also in the dark field as well as in phase contrast (methods of examination in which the "colour" quality of the light to be used for illumination plays no part within very great ranges, as long as no definite effects have to be obtained). In all other methods of observation these types of lamp are not *generally* adoptable, since their emission is limited in the regions of very large wavelengths to *few lines* (cf. fig. 5). Here technical reasons in connection with colour and film play a special part. Damage—to a certain extent irreversible—is found in a short time in living material that has to be examined when it is radiated with light that is rich in ultra-violet rays ; but this fact can be neglected, since the effect can be eliminated by suitable filtering.

In the case of visual observation of a colour preparation, however, its reproduction *in correct colours* is impossible because of the absence of certain portions of the visible spectrum, whilst when photographing in black and white the tone values are altered, thus rendering the interpretation of such pictures at least difficult. For microphotographs *in colours*—whether single pictures or cinema films—the mercury vapour burner is absolutely unusable in consequence of the great colour alterations

that occur in the great majority of cases (exception : fluorescence microscopy). Reference will be made later to another property peculiar to all gas filled lamps, when we come to speak of the *xenon lamp.*

Carbon arc lamps : The arc produced between two separate carbon rods, with values between 12,000 and 18,000 sb, represents even to-day the most intense source of light emitting approximately white light. Because of this emission similar to daylight, the carbon arc lamp would also have to be described as excellent for microscopic examination, but on the other hand it possesses properties which greatly limit its use. These types of lamp require permanent supervision, since the separate carbon rods do not burn for longer than a few hours. In addition to that, there are fluctuations in the intensity of the radiation which are to be attributed partly to irregular combustion of the carbons in consequence of lack of homogenity of the material, and this cannot be entirely avoided, and also partly to inaccurate feed of the carbon rods, since it is actually difficult to maintain them perfectly in adjustment. Besides this "aperiodic flickering," there is a periodic fluctuation of the light intensity when working with alternating current—as in the case of gas discharge tubes—this fluctuation taking place in rhythm with the frequency of the supply system. (With regard to this, see the section on the xenon lamp.) While these irregularities can easily be neglected in the case of visual observing, in single picture microphotography and in projection, they express themselves in microcinematography in such a way as to cause irregular exhibition of the separate pictures, so that the value of such documents is much diminished. The use of the carbon arc lamp has therefore become principally limited to projection.

Flashlight appliances : Although the lighting of a microscopic object by vacuum or electron flash lamps cannot be described as customary, since they fall out of consideration for any visual observing (in the first case certainly, in the second case temporarily), these types of lamp nevertheless bridge-over certain large gaps in microphotography and microcinematography. Their use is particuarly evident when it is a question of taking a photograph of some living material that is moving quickly or is very sensitive to temperature. The times of exposure required for this, often extremely short, may only be attained by these special lamps whose discharging time fluctuates between 1/250 and 1/5,000 of a second, during which time considerable amounts of energy are set free, up to 600 joules for the usual commercial electronic flashlight apparatus.

In the case of vacuum flashlight lamps, depending on their type, the spectral composition of the rays agrees either with the colour film material used for artificial light or with the colour film material used for daylight ; whilst in the case of electron flashlight tubes, it agrees to a great extent with that of daylight (colour temperatures up to 6,000° K).

In microcinematography, vacuum flashlight lamps are for evident reasons not adoptable, whilst the introduction of electron flashlight lamps is limited in so far as it is only possible in the case of *time-lapse-motion* photographs, whereby the picture frequency must be less than 5–20 pictures per minute (charging time of the charging appliance differing according to its make).

Characteristics of some microscope light-sources :

Light source	*Brightness* (sb) *abt.*	*Colour temperature* (°K) *abt.*
Average daylight (mixed sunlight and skylight)	—	6,500
Usual commercial incandescent lamp (100 W, 220 V)	600	2,750
Low-voltage incandescent lamp (20 W, 6 V)	1,500	3,200
Carbon arc lamp (500 W)	12,000	4,500
Mercury vapour high-pressure lamp (200 W)	25,000	—
Vacuum flash lamp	—	3,700 *or* 5,200
Electron flashlight tubes (200 W) ...	—	6,000
Xenon high-pressure lamp (160 W) ...	*9,000*	*5,200*
Surface of the sun (as comparison)	150,000	5,000 *to* 7,000

DEMANDS MADE BY MICROSCOPIC PRACTICE ON A UNIVERSALLY ADOPTABLE SOURCE OF LIGHT

An artificial source of light could be described as ideal for microscopy if it possessed all the advantages of the mentioned types of lamp without including any of their drawbacks. We shall therefore refer once again briefly and comprehensively to the separate interesting questions.

Brightness of light : It has already been pointed out that the Köhler principle of lighting, which has proved to be by far the best method of illumination for microscopy and therefore become well established, theoretically starts with a *point-shaped* source of light (which, of course, is not strictly realisable in practice). Because of this requirement the whole performance of the adopted type of lamp becomes of less importance than its brightness, since only the latter represents a scale for the strength of light *utilised* by the optical system of the lamp. Great brightness of a light source is necessary for using it in an observation process that absorbs much light, such as dark field, fluorescence, phase-contrast and polarization. More than with visual observing there are here, particularly in the case of microphotographs and cinemaphotographs, special problems, since the reproduction of living, moving

material requires very short exposures, whether taking a single photograph or a film at normal frequency (16–24 frames per second).

Colour temperature : The reproduction in proper colour and shading of an object presumes in general that the spectral composition of the light utilised for illumination corresponds in the visible range to that of daylight.[3] The selective dyeings of microscopic technique with their wide possibilities of differentiation form no exception here. Each change of the quality of the light has alterations in colour in a certain direction, and these make a diagnosis difficult, and in some cases often impossible.

In addition to that, with the tendency perceptible to-day also in scientific circles for a far-reaching rationalisation of working methods and materials, the *daylight colour film* is becoming always more and more adopted. With a correcting filter it is at once possible to photograph

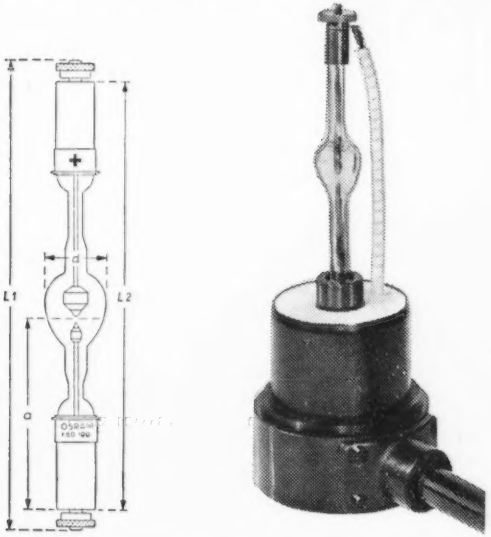


Fig. 6. Drawing and view of Xenon high-pressure lamp XBO 162.

with artificial light, and this type of film allows of a quick change from micro to macro and normal photographs in daylight, whereby its sensitivity, which is generally very high with respect to the artificial light film, may in all cases be of great importance. In the invisible region of the

(3) In the invisible range of light, in fluorescence, ultraviolet and infrared microscopy, other scales hold good in this respect. Technical details from Osram, Siemens, and Wild.

spectrum a source of light that can be universally adopted should emit both ultra-violet and infra-red rays, since the adoption of such methods of observation is generally usual to-day. In addition, both types of rays can be entirely eliminated by suitable filters if they are not required.

Variable intensity : The intensity of a source of light adopted for a microscope should be changeable *without* altering its spectral composition in one direction or the other. The fulfilment of this requirement

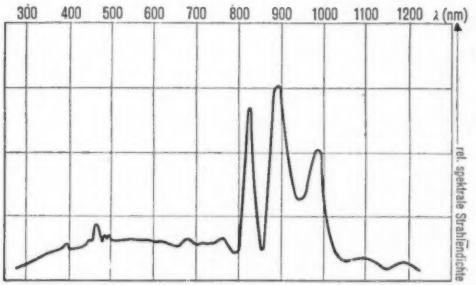


Fig. 7. Spectral emission curve of the Xenon high-pressure lamp XBO 162 (middle of the arc). (Right) Relative spectral density of radiation.

forms the basis for suiting the lighting rapidly and perfectly to the always changing scales of picture when observing, and also to the very great difference of the separate methods of investigation, whose light requirements may fluctuate at any time to the extent of 1 : 1,000.

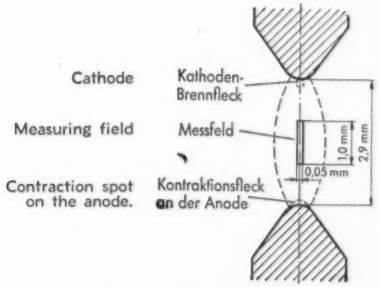
THE XENON HIGH-PRESSURE LAMP AND ITS PROPERTIES

The Xenon lamp represents a source of light which complies to a great extent to most of the requirements mentioned. Starting with it, close collaboration between the microscopic department of *Wild Ltd., Heerbrugg*, and the laboratories of *Osram* and *Siemens* has resulted in the development of a universal lamp for microscopy, which takes into account the manifold wishes of the research worker and the practical man. The new development is based above all on the adoption of the Xenon high-pressure burner XBO 162 of Osram, for which Siemens has built the electrical equipment and Wild Heerbrugg the mechanical-opitcal accessories.

The Xenon high-pressure lamp (cf. fig 6), as air-cooled gaseous discharge tubes, emits a *continuous* spectrum which shows in an unbroken series all colours of the visible range from 430–700 nm (cf. fig. 7).

In the range of the medium and longwave ultra-violet rays (230–430 nm), the Xenon burner also emits a practically continuous spectrum, but its radiation is less than in mercury high-pressure lamps of corresponding size. In the shortwave infra-red range (800–1,000 nm) a further maximum radiation is available.

The illuminating intensity of the Xenon lamp with about 9,000 sb corresponds to about 6–10 times the value of a modern low-voltage flat filament lamp, usually adopted for microscopy in the case of normal voltage.



Position of the measuring field (diagrammatic).

The colour temperature of the emitted light (abt. 5,200° K) is very similar to that of average daylight ; the Xenon lamp supplies "white" light. In that case, by throttling the amount of current, the illuminating intensity can be continuously varied in a ratio of approximately 1 : 5, without the colour temperature of the radiation changing. The bulb of the burner consists of quartz and is therefore also suitable for short-wave lenghts.

The ignition voltage of the Xenon lamp XBO 162 amounts to 20,000 V (500 hertz), the working voltage to 20 V (direct current), and then a special ignition electrode is unnecessary. Immediately after switching the lamp on, the illuminating intensity reaches 90% of the maximum, which is attained after burning for a few minutes. When the lamp has been switched off, it can at once be lighted again. The discharging arc of the XBO 162 has the shape of a solid of revolution 2.2. mm. long and about 1.1 mm. wide, and having the illumination intensity at the cathode 10 times as great as in the middle. All technical data regarding performance, however, depend on measurements which were made in a small field of about 1.0 × 0.5 nm which is practically utilised (cf. fig. 8). The gas pressure within the burner is 10 atm. gauge when in the cold state, and about 25 atm. gauge when under working conditions.

In consequence of its practical importance, we shall here make special mention of another property common to all gaseous discharge tubes (Xenon, Hg, Na, etc.).

These types of lamps may be fed with direct current as well as with alternaing current. In both cases the number of discharges occurring in the lamp per unit of time depends on the frequency of the supply (50 Hz).

When working with alternating current, since the discharges take place without inertia, this means that a gaseous discharge tube ignites and again extinguishes 100 times per second. (In the same interval of time the voltage passes just as many times through the zero point.) In consequence of this, there is on the other hand an *intermittent* lighting current, which can be neglected in the case of visual observation, but causes *stroboscopic* effects in microcinematography at normal and very quick frequencies (16 frames per second or slow-motion photography), and these effects for their part express themselves in a periodic change of bright and dark pictures in consequence of non-uniform lighting.

On the other hand the mentioned gaseous discharge lamps are for several reasons designed of such a si e that the *greatest admissible* tube current is taken equal to the amplitude of the alternating current. From this it results that, when using a lamp with this type of current, we have only *half the illuminating intensity* in comparison to what is had when working with direct current. The maximum capacity obtainable is thus not utilised. In addition to that, the periodic reversal of the alternating current stresses the lamp electrodes much more severely, and this has an unfavourable effect on the life of the lamp.

For these reasons gaseous discharge tubes are whenever possible worked with *direct current*, and then the time constant of the radiation is still further improved by additional electrical equipment (voltage smoothers).

The Xenon high-pressure lamp XBO 162 which has come into use for technical microscopic research is therefore only intended for working with direct current, whereby a portable appliance connected in series and containing the igniting mechanism and the necessary fuses, supplies the desired direct current with very slight ripple.

THE UNIVERSAL LAMP

The air-cooled *lamp casing* specially constructed for taking highly compressed gaseous discharge tubes (Xenon and mercury vapour high-pressure burners) (cf. fig 9 and 10) is fixed on a small stand and can be tilted. This casing is firmly connected to the microscope by a connecting rail, thus ensuring steady guiding of the rays. The robustly built lamp body can be chosen as desired, and even in combination with the following light sources :

Xenon high-pressure lamp, mercury high-pressure lamp, low-voltage band lamp, low-voltage incandescent spiral lamp, spectral lamps (of various line spectra), electron flashlight tubes, vacuum flashlight bulbs.

The mechanism and the optical system are calculated in such a way that all mentioned types of lamp complying with the rules of the *Kohler lighting principle*, can therefore be used technically under optimum lighting qualifications. Four openings, suitably distributed on the lamp casing, receive the separate light sources and accessories.

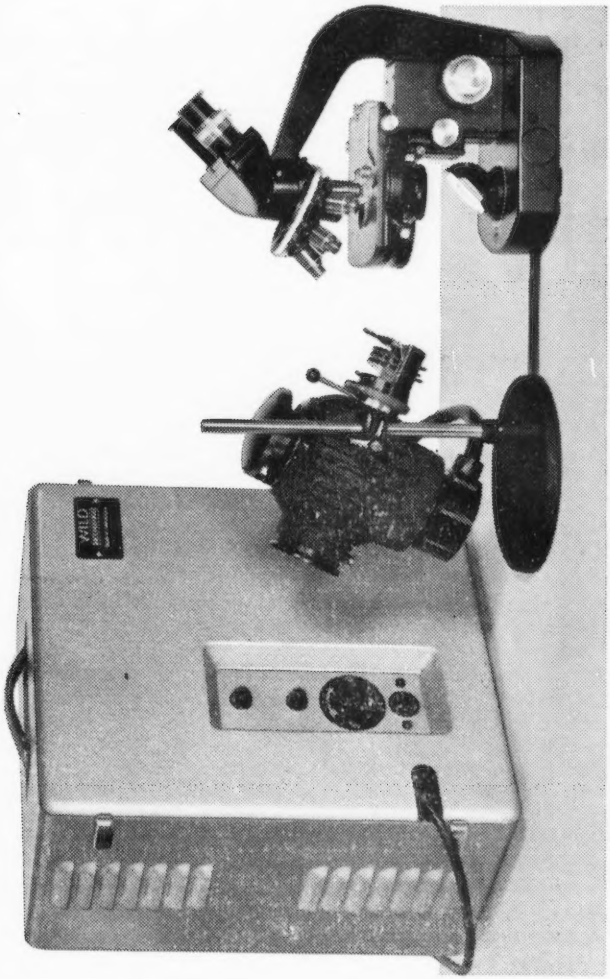


Fig. 9. View of the whole plant of the universal lamp with Xenon burner; at the left: series appliance; at the right: Wild microscope M20 with cold-light mirror in ball setting.

In the front opening, which lies in the optical axis, the *quartz collector* belonging to the standard equipment is inserted. This collector carries the built-in lighting-field diaphragm and a ground glass which can be deflected. A UV-filter, which can also be tilted, is built onto it. A special filter-holder serves as carrier for a further six filters. When using the Xenon or mercury vapour high-pressure lamp, an *additional collector* is inserted into the normal collector, so that the illuminating of the inlet pupil of the microscope is ensured up to the highest illuminating apertures (1.30) even with these types of lamp.

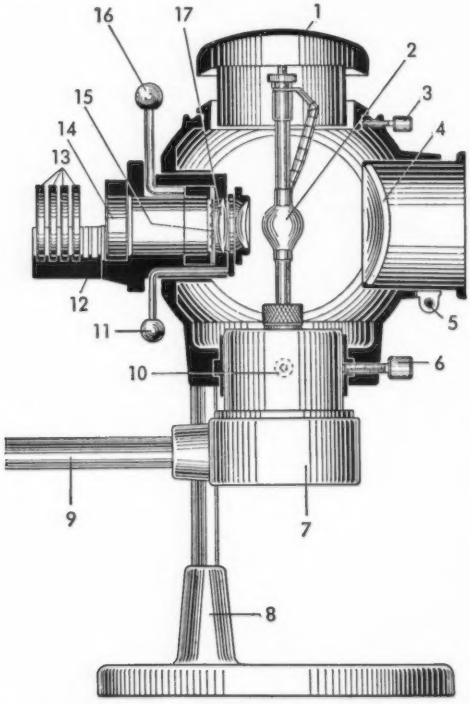


Fig. 10. Cross-section through the lamp casing of Wild universal lamp.

1, Protecting cap; 2, Xenon burner XBO 162; 3, Clamping screw for protecting cap; 4, Concave mirror; 5, Clamping screw for mirror; 6, Clamping screw for burner; 7, Lamp socket; 8, Stand; 9, Cable; 10, Centering screw; 11, Operating lever for ground glass; 12, Filter carrier; 13, Grey and coloured filter (can be swung out); 14, UV protecting filter (can be swung out); 15, Light-filter diaphragm B6; 16, Operating lever for light-filter diaphragm; 17, Quartz collector.

Both gaseous discharge tubes are inserted into the lamp casing in a special setting from below and adjusted accurately in the path of the rays of the apparatus by means of a centering device. For the correct centering of the light source, there is also a *concave mirror* located in the rear opening of the lamp body. For microphotographic or micro-cinematographic pictures(slow motion) with the *electron flashlight*, in place of this mirror, the additional lighting for visual observing of the preparation (between the several photographs) can be fixed on the lamp casing, the flashlight tube being pushed into the casing from above. In all other cases the upper opening is covered by a cooling cap.

Also the various *spectral lamps* intended for chemical-physical and spectroscopic investigations are inserted from below into the universal lamp.

All operating elements required for the perfect setting of the illumination are arranged conveniently and in such a way that it is not necessary for the observer to leave his working position to manipulate them.

We are grateful to Wild of South Africa (Pty.) Ltd. for permission to publish this article.

ABSTRACTS

The Breakage of Glass Ampoules during Freeze-drying. Verma, N. S. and Rowe, T. U. G. *Vacuum*, 9.1.21 (1959).

One of the annoyances of lyophylisation has been the inexplicable breakage of ampoules during the primary process. The authors have investigated fully and conclude that breakage can be prevented by coating the interior of the ampoules with a proprietary silicone. The coating is fairly resistent to washing, non-toxic to bacteria and to the virus of Newcastle disease.

Preservation of Microbiological Assay Organisms by Direct Freezing. Tanguay, A. E. *Applied Microbiol*, 7.2.84 (1959).

The freezing of suspensions of organisms in a deep-freeze using a menstruum of M/15 phosphate buffer with 15% glycerol is de cribed Test inoclua frozen (slowly) and stored at —40°C. maintained a satisfactory growth response foı from 6 months to 1 year or more.

NOTICE

NATAL BRANCH

Mr. P. N. Buck has tendered his resignation as Hon. Secretary-Treasurer of the Branch as he feels that he can no longer devote sufficient time to the position. In accepting his decision the Committee expressed appreciation of the way in which he has served the Branch in the past. Miss M. A. E. Bennett will act as Hon. Secretary-Treasurer in the meantime : c/o. Medical School, University of Natal, Umbilo Road, Durban.

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AMENDMENTS TO THE CONSTITUTION

1. That the second sentence of Section 5 d. read simply that "The approved Affiliated Members shall not be allowed to vote."
2. That the word "voting" be deleted from the sentence in Section 11 ii of the Constitution dealing with a quorum.

ERRATUM

Vol. 5, No. 2, page 25. For "adsorption" at the end of line 8 read "absorption."

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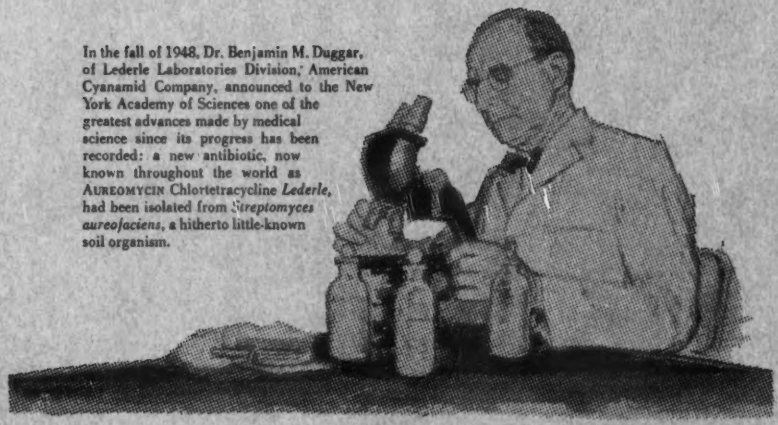

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